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A

Mechanical ESSAY UPON THE HEART.

In Three Anatomical LECTURES.

WHEREIN

- I. The HEART is demonstrated to be a compleat Epitome of *Myology* in general, from a new and particular Illustration of its compounding Muscles.
- II. The Origin and Nature of the BLOOD, with a very exact Description of its Circulation; deduced from the Force and Elasticity of a Fibre; from the Situation and Construction of the Veins and Arteries; and from the stated Principles of Mechanicks.
- III. The Praeternatural State of that Fluid; and how to restore it, when possible, to its natural *Crasis* again.

As deliver'd at

The GULSTONIAN LECTURE in the Amphitheatre
of the Royal College of Physicians, London; on
the 23d, 24th, and 25th Days of October, 1727.

By WILLIAM WOOD, M. D. K

Fellow of the said COLLEGE.

Illustrated with COPPER-PLATES.

L O N D O N:

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TO
HIS GRACE
F O H N,
Duke of *MONTAGU,*

Marquis of *Mont-Hermer*, Earl *Montagu*, Viscount
Mont-Hermer, Baron *Montagu*, Master of the Great Ward-
Robe, Lord Lieutenant of the County of *Northampton*,
Lord Lieutenant and *Custos Rotulorum* of *Warwickshire*,
Lord Proprietor and Captain-General of the Islands of
St. Lucia and *St. Vincent*, Knight of the Most Noble Order
of the *Garter*, and Grand Master of the most Honourable
Order of the *BATH*, &c.

SIR,



OUR GRACE's free and generous
Condescension to Subscribe the Sta-
tutes of our Royal College of Phy-
sicians, justly commands a very par-
ticular Acknowledgment from every individual
Member thereof, for so great and singular an
Honour done him upon that Occasion.

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'T IS

DEDICATION.

'T IS upon this Account, GREAT SIR, that I presume to dedicate these following *Lectures* to Your GRACE, hoping your usual Complaisance and Good-Nature will excuse the Boldness of this Attempt; and, as I meant it, look upon it as an Instance of my profound Respect and Gratitude.

DUTY, My L O R D, and a sort of Vassalage is a farther Obligation upon me to make Your GRACE this humble Offering. At present I enjoy a small Customary Estate where your Noble Ancestors have long been Lords Paramount. Indulgent Fortune has made Your GRACE a Guardian, as it were, over me in that Respect, and I hope You will vouchsafe me the Honour of Your Countenance and Protection in this.

THE Subject treated of in the following Sheets, My LORD, is the *Heart*; that glorious Fountain thro' which the ennobled Blood of the MONTAGU'S has for many Ages past stream'd with an unblemish'd Tide. A long and happy Continuance thereof in Your GRACE, for the Service of the Crown, for the Ornament of Your Country, and for the common Good of Mankind, is the sincere Wish of Your GRACE's

*Most dutiful and
Most devoted humble Servant,*

W. WOOD.



THE P R E F A C E.



HE Useful and Honourable Profession of Physick is now arriv'd at a very extraordinary degree of Perfection, by the many nice and accurate Discoveries of the antient and modern Anatomists. All the Literati have generously from time to time communicated whatever they judged curious and new in this way, so that any one Physician with a tolerable competency of this sort of Knowledge, may, with an unprejudiced Knack of Reasoning, in a purely mechanick way, easily explain the whole Animal System, distinguish the various Causes of almost all Distempers from their Effects, and accordingly prescribe with Success and Reputation.

SO absolutely necessary is Anatomy in the Practice of Physick, that without it all is Random and Chimera. Anatomy is, as it were, the Pole-star both to guide and direct us. It points out to us the Seat and Origine of all Maladies: It discovers the Communication of one part with another; and so consequently, like Ariadne's Clue, conducts us through the, otherwise, inextricable Labyrinth of complicated and different Symptoms, which are as necessary to be known, as necessary to be reliev'd.

WHEREAS, on the contrary, a Physician, who is not expert in Anatomy, must be eternally perplex'd with almost every Case he meets. He's forced every now and then to prescribe in the dark, without either a Why or a Wherefore; and often loses his Patient by not knowing the real Cause of the impending Danger. Upon this account,

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RECEIPTS and Family Nostrums, which too many are so very fond of, have seldom or never their desir'd Effects, tho' possibly writ by the best Hand in the Profession of Physick; because these Receipts were originally design'd for other Patients, tho' probably labouring under the same Distemper: for so different are Constitutions, that 'tis very difficult, if not impossible, to find two Persons exactly agreeing in every Circumstance; nay, the very individual Person, when visited a second time with the same Distemper, must very often be treated after a very different Process from the former; a great many Circumstances so requiring at that critical Juncture.

THE Peruvian Bark is justly call'd a Specifick Remedy in intermitting Fevers; but it is only to be understood as such when properly order'd: for let the Drug be never so good in its Nature, yet it is still meliorated by the Skill of an able Physician; neither its Quantity nor Quality availing, as thousands by woful Experience can attest, who have hand over head taken an extravagant Quantity either to no purpose, or a very bad one.

IN short, all good Medicines are really specifick Remedies when judiciously apply'd, and directed to proper Diseases. Hence all Cures wrought by the help of Receipts, are at best but guess-work; and Miscarriages this way should never bring any good Medicine into contempt, because the very best in the hands of a Bungler are very often attended with very fatal Consequences. Thus a great many (otherwise Persons of very good Sense) have taken extravagant Prejudices against the Bark, for Instance, Mercurial Preparations, Opium, &c. merely because some Friend or Acquaintance of theirs have suffer'd by the unskilful Administration of some of the abovesaid Medicines. But to return:

ANATOMY, as it is the Touchstone of Practice, so it naturally leads us in the real and mechanical Operation of Drugs, as well as the Rationale of an Animal Body. That

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vaunted, but trite Sham of Old and Experienced, as well as being long acquainted with a Person's Constitution, is so stale a Banter upon Mankind, that none can swallow it down at this time of day but ignorant or unthinking People. 'Tis true, something may be said for long Experience when attended with a Rationale of Anatomy; but without that Rationale, Experience is neither better nor worse than downright Quackery and Imposture. As for a long Acquaintance with a Patient's Constitution, that is a mere Juggle too, for a dextrous Physician will find out that pretended Secret by asking three or four Questions at most.

AGAIN, so indispensably necessary is Anatomy, that 'tis impossible to read and relish a good Author in Physick without it. Without a competency of this sort of Knowledge, several have even quite lost the very means of attaining to a tolerable Pitch in their Profession, by a blind and implicit Resignation to some pompous Hypothesis, tinsell'd o'er with a pack of whimsical and unintelligible Terms.

A Student in Physick must proceed in that Method which the Schoolmen call Synthetica; he must advance by a regular Climax, from the most simple things to the most compounded; and then he can never be at a loss upon any Emergency. His Anatomical Elements (as Euclid's does a young Mathematician) will infallibly direct him in the search of an infinity of undeniable Truths: For an Human Body is the Epitome of every other Machine that is or ever will be invented; and every part of an Human Body, as well as the whole, is as capable, when rightly understood, of as nice and mathematical Demonstrations, as any other part in Mechanicks or Natural Philosophy.

HENCE the many and voluminous Books which have been writ upon Practice, are, at best, but so many worthless Quack-Bills foisted upon Mankind to introduce the Authors of them to a little Vogue in their Profession: For in Physick, there is a Je-ne-sçay-quoi, which can neither be taught nor learn'd.

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learn'd. A Physician must reason himself into this Science from the Elements of Anatomy by a truly mechanical Turn of Thinking. By this means he finds out and distinguishes the real Cause of his Patient's Complaint, and can demonstrate the Certainty of his Process in the Cure. Thus he prescribes according to the Dictates of Nature, and may justly prefer his own Judgment built upon such a Foundation, to a Sett of ridiculous and dogmatical Systems.

UPON this View, Dr. GULSTON, formerly Fellow of the Royal College of Physicians here in London, Founded and Endow'd these ANNUAL LECTURES. He knew how absolutely necessary Anatomy was to the understanding of the Practice of Physick; and order'd that some particular part of an Human Body, by way of Introduction, should be readupon; thence to demonstrate the Phænomena of every Distemper incident to that Part, and to assign a proper Cure accordingly. In these following LECTURES upon the HEART, which I read (in obedience to the Command of our worthy President, Sir HANS SLOANE) in our Amphitheatre, I have observ'd the Direction and Intent of the Founder, as exactly as I possibly could.

HOW my Performance may please, I dare not say. If it meets with Approbation, I have my desir'd Wish upon several Accounts; if it does not please, I hope some of my Readers, at least, will be so candid as to inform me how to correct it, both for my own sake in particular, and for that of the Republick of Physick in general: The whole Animal OEcconomy, with the principal Phænomena in Practice, depending upon an exact Knowledge of these very Solids and Fluids which I have attempted in these LECTURES.



A

Mechanical ESSAY
UPON THE
HEART, &c.
In Three LECTURES.

LECTURE I.



HE Worthy Dr. GULSTON, formerly Fellow of this *Royal College of Physicians*, who instituted this *Anatomical Lecture*, directed that it should be read upon some particular Part or Parts of an Human Body, with the proper Distempers incident thereunto; wisely considering the absolute Necessity which every Practitioner in Physick lies under, to know exactly the Anatomy of the Part

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affected,

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affected, in order to find out the true and real Cause, before he can judiciously effect the Cure.

THEREFORE, in perfect Obedience to our generous Benefactor's Will, I shall, as minutely as I can possibly, describe the constituent and concomitant Parts of the Heart, which is the Subject allotted me, in this Lecture.

IN the next Lecture, I propose to explain the Nature and Origin of that Fluid call'd *Blood*, with its proper Vessels of Conveyance, namely, the Veins and Arteries, by way of Introduction, the better to demonstrate how the Circulation of the Blood, in its natural State, is perform'd in an Human Body.

BY this Method, I shall be the better enabled to show where and how the Malady begins, and consequently be the better intitled to propose a Remedy, which I humbly offer to the Judgment of this learned Assembly: And this will be the Subject of my third and last Lecture upon the Heart.

TO begin;

THE Heart, in Figure, resembles an obtuse Cone, whose Apex or Point hangs downward, a little inclining to the left Side. In this Situation, the right *Auricle* is lower than the left. Its Base, which is uppermost, is suspended in the Center of the *Thorax* by those great Vessels, which are instrumental in conveying the Blood to and from the right and left *Sinus's* of the Heart. [See Fig. 1. Plate 1.]

THE Heart is included in a Membranous *Capsula*, or Bag, call'd *Pericardium*, of the same Shape and Figure with itself, lying in that Duplicature of the *Pleura*, which is call'd *Medastinum*, because it divides the Cavity of the Breast into two equal Parts.

THE *Pericardium* adheres very firmly to this Membrane, and its Point is strongly ty'd to the middle Tendon of the *Septum transversum*, as was first observed by the famous Dr. Lower, to facilitate its *Diastole* in Expiration: But the *Pericardium* is loose in Quadrupeds, lest it should impede its *Systole* in Inspiration.

THE *Pericardium* contains a *Lympha*, which ouzes partly from its proper Glandular Coat, and partly from a number of other little Glands, which are form'd by the *Coronary Veins* and *Arteries*, and lie buried in the fat Substance upon the Basis of the Heart. This Liquor, like that which issues from the *Lachrymal-Glands* of the Eyes, is of infinite Use to moisten the Heart. Thus are its Fibres preserv'd from growing dry and crispy, which otherwise would necessarily shrivel and corrugate, and so be render'd unfit for that constant and regular Motion which is so essential to Life.

THE *Pericardium* has its Blood-Vessels from the *Mammariae* and *Phrenicæ*. It has one particular Vein call'd the *Capsulary Vein*, which carries the Blood back into the *Axillary Vein*; but all its Veins else are call'd after the Arteries. It has several small Twigs of Nerves which spring from the Recurrent and *Par Vagum*. It has *Lymphaducts*, which discharge the superabundant *Lympha*, just mention'd, into the *Thoracick Duct*. It has likewise five Perforations, or Holes for the Exit and Entrance of the great Blood-Vessels of the Heart.

THE Heart, which is the principal and most noble Bowel of the whole Body, is a strong compacted Muscle composed of Arteries, Veins, Nerves, Lymphaticks, a Membrane, and fleshy Fibres.

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THE Arteries are call'd *Coronariæ*, and are two in number. They spring from the *Aorta*, a little before it passes out of the *Pericardium*, and immediately behind the *Valvulae Semilunares*. One of them runs down the foreside of the Heart in the Furrow which lies between the two Ventricle, where it sends off a great many Branches, which dip into the various Complications of the Fibres; and having reach'd the Apex, it mounts again, and inosculates with the other which issues from the right-side of the *Aorta*, near the first, and runs obliquely down between the right *Auricle*, and the right Ventricle towards the back part of the Heart. These Arteries, as well as the Veins, are call'd *Coronariæ*, because they divide into a great many small Branches, and form a *Plexus* like a Crown, which surround the Basis. They bring constant Supplies of Blood to warm and regale the Heart. [See Fig. 3. Plate 1. Fig. 1. Plate 1. and Fig. 3. Plate 2.]

THERE are likewise two Veins call'd *Coronariæ*, for the reason aforesaid. These unite with the Capillary Branches of the Arteries, carry back the remainder of the Blood, and discharge it in the *Vena Cava*, a little before it enters the right *Auricle*. [See Fig. 2, 5. Plate 1.]

THESE Veins also communicate with one another by *Anastomoses*; and a Liquor injected only into one of them runs into the other.

THE Heart has likewise several *Lymphatick* Vessels, which discharge themselves in the *Thoracick Duct*.

THE Heart has Nerves from the *Par Vagum*, or eighth Pair, which form a *Plexus*, call'd *Cardiacus*. These Nerves enter in at the Base, but chiefly about the *Aorta* and left

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Ventricle, and afterward insinuate themselves through the whole Substance of the Heart to invigorate it with animal Spirits.

THE Heart is circumscrib'd by a very fine Membrane, which adheres so firmly to its muscular Fibres, that it is very difficult to separate them. Immediately underneath this, lies a fatty Substance, but more particularly upon the Basis at the Exit and Entrance of the four great Blood-Vessels. This Fat is of wondrous Use to lubricate, and consequently to facilitate their Motion in the various *Systoles* and *Diastoles* of the Heart.

IN the Basis of the Heart lie several Tendons, which surround the left Ventricle, and the *Aorta*. The Entry of the right Ventricle is likewise tendinous, but the Fibres which terminate about the Pulmonary Artery, terminate fleshy. These tendinous Ringlets, like so many Ferrels, not only serve to fortify these great Vessels at their Union with the Basis of the Heart, but are of infinite Use and Contrivance for the Rise and Insertion of all the Fibres which compose the Heart. These Tendons, like Cartilages in old Men, grow bony in several Animals; and sometimes they are found *Ossified* in Men. [See Fig. 1. Plate 2.]

THE Fibres, which run from, and are inserted into these Tendons, are in different Plans, and lie upon one another in different Directions, being wound up together like a Clew of Thread.

FOR the Heart, as it is the Epitome of all Muscular Motion in Nature, so it is an Abstract or Compendium of Muscular Construction in general; the Fibres, which form this Bowel, containing all the different Species of Muscles in Animal Life. The number of all these different Species of Muscles is reckon'd eight by *Borelli*, Cap. 2. Prop. 3. of his incomparable Book *De motu Animalium*.

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THIS I am going to exemplify in the Myological Description of this wonderful Machine. And as the Attempt is intirely new (to the best of my Knowledge) so I hope, should I not exactly succeed, I am in a great measure excusable upon that account.

I proceed thus:

Musculi Prismatidirecti. THE first of these eight Species is a Range of fleshy Fibres in form of a rectangular Prism, and are accordingly call'd *Musculi Prismatici directi*. [See Plate 2. Fig. 2.]

THUS that Plan of Fibres, which is the first and outmost, and by much the finest of all, runs at right Angles from their Origin in the Tendon of the right Ventricle, and from the side of the Pulmonary Artery in straight Lines, and terminate on the Point of the Heart, which exactly agree with this first Species. [See Plate 2. Fig. 7.]

Musculi Rhomboidales.

THE second Species is from Fibres running obliquely from their Rise, and form an oblique-angled Prism, and are commonly call'd *Musculi Rhomboidales*. This Species is evidently seen lying immediately under the straight Fibres of the Heart just mention'd. They have their Origin from the Tendons encircling the *Aorta* and left Ventricle, winding obliquely to the right side downwards to the Apex, when they ascend again by several spiral Circumvolutions upon the left Ventricle, till they reach the Basis of the Heart, where they are inserted. [See Plate 2. Fig. 7, & 3.]

Musculi Spirales Orbicularis.

THESE Windings form likewise the third Species of Muscles, which are call'd *Musculi Spirales Orbiculares*. [See Plate 2. Fig. 2, 3, 4, 6, & 7.]

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THE next Range of Fibres in the Heart are likewise *Rhomboidales*, and run directly contrary to the last, namely, from the right side to the left, and winding about both Ventracles, mount again spirally to their Insertion in the Tendons of the Basis. This Plan, with the last, being both oblique Prisms, form a fourth Species, call'd *Musculi Decussati*. [See Fig. 7. *Decussati*. Plate 2.]

UNDER the straight Fibres there are a few which almost run in right Lines issuing from the opposite sides of the Pulmonary Artery, and are inserted into the second Tendon of the *Aorta* on one side, and into the Mouth of the right Ventricle on the other. These two Plans of Fibres are reducible to the fifth Species of Muscles, call'd *Musculi Penniformes*. [See *Musculi Penniformes*. Fig. 1. Plate 2.]

FROM the first Tendon of the *Aorta*, there are several other Fibres descending half-way downwards obliquely to the Apex, making a few spiral Circumvolutions round the right Ventricle, ascend afterwards either to be inserted into the Tendon of the Pulmonary Artery, or lose themselves in the fleshy Pillars, or *Papille* in the inside of the right Ventricle.

FROM what I have already explain'd, it is evident, that all the Fibres, which compose the Heart, issuing from the Tendons in its Basis, like so many Rays from a common Center, form the sixth Species, call'd *Muscui Radiosi*. And, again, *Musculi Radiosi*. 'tis no less evident, that the Tendons which give Rise to these Fibres, and where mostly they are inserted, being only so many Ringlets of a finer sort of Fibres very firmly and closely compacted, form a seventh Species of Muscles, call'd *Sphincteres Circulares*; which will appear more plain in the Sequel of *Circulares*. these Lectures. [See Fig. 1. Plate 2.]

BUT besides these Tendons, there are likewise Semicircular Fibres which surround the two Ventricles, which are of extraordinary

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dinary Use in assisting the Valves during the *Systole* of the Heart.

FROM the various Windings of the Fibres, which I have been speaking of, are form'd the right and left Ventricle, which, by unravelling the Clue, separate themselves from each other, and are intirely distinct. The left Ventricle is much stronger, having a great many more Fibres winding about it than the right Ventricle. The left is narrower and longer; but the right Ventricle is the wider and shorter of the two, and seemingly the larger in Capacity: the left has likewise more Nerves entring into it, in proportion to its Fibres. They have a Partition-Wall, which is call'd the *Septum*.

Musculi
Complicati.

THE *Septum* is a strong fibrous Part, being exactly of the same Substance with the Ventricle. From its Tendon in the Basis of the Heart, go all the Fibres which compose it, some of them running in straight Lines, terminate in the Apex; others, at all the intermediate Distances, twist themselves round the left Ventricle. In their Circumvolutions they are wove with the *Decussati* mention'd above, and form the eighth and last Species, call'd *Musculi Complicati, sive Musculi compositi ex fasciculis Fibrarum complicatarum*. These Fibres afterwards either are inserted into the Basis on the opposite side, or terminate in fleshy Pillars, or *Papillæ*, in the inside of the left Ventricle. This *Septum* is convex on the side of the right Ventricle; and in regard of this Ventricle's Weakness, it sends off a pretty strong and round Muscular Plan of Fibres, which surround its greatest Circumference. [See Fig. 2. Plate 2.]

THE left Ventricle lies on the opposite side of the *Septum*, which is concave, and makes a part of the inside of the Ventricle, having, as I observ'd but just now, a great many of its Fibres interwoven with those that constitute it. Therefore, tho' the *Septum* generally belongs to both the Ventricles, yet it more particularly belongs to the left. [See Plate 1. Fig. 4.]

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THE Inside of both Ventricle has a great many Furrows, which are much deeper and larger, and likewise more in Number in the left than the right.

IN the Cavities of both Ventricle there are also a great Number of fibrous Productions, long and round, different both in Shape and Size. These are the Fibres which did not mount outwardly, to be inserted with the others in the Tendon of the Basis of the Heart, but terminated in the Cavity, to form the *Papillæ* or *Columnæ*. The right Ventricle, being much thinner than the left, has a tendinous Pillar of several Fibres running from the *Septum*, or middle Partition, to its opposite Side, to prevent too great a Dilatation in its *Diaستole*, and to assist in the *Systole* of the said Ventricle. [See Fig. 4. Plate 1.]

THE other fibrous Productions, rising mostly from the Bottom of the Ventricle, mount upwards in tendinous Strings to be inserted into the *Valves*, call'd *Tricuspidæ* from their Triangular Figure. These *Valves* are made of a thin strong Membrane, and are circularly inserted into the Tendon, which surrounds the Mouth of the right Ventricle. [See Fig. 5. Plate 1.]

IN the left these fibrous Productions (as in the right) go to be inserted into the *Membranæ Mitrales*: So call'd from their Likeness to a Mitre. These Membranous *Valves* are circularly inserted into the Tendon, which surrounds the left Ventricle. [See Fig. 4. Plate 1.]

ADJOINING to the Basis are two more Cavities as Appendages to the Heart, lying upon the two Ventricle, which are call'd *Auriculæ*, from the Resemblance they have of an human Ear. They have an obtuse Point, which, with their Base or Origination, form an Obtuse Triangle. They are divided into right and left Auricles because of their Situation. They are compos'd of two Plans of Fibres, which are oblique Prisms, and de-

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cussate each other. They have their Origin from a circular Tendon, which joins the *Vena Cava* on the right Side, and the *Vena Pulmonalis* on the left. These two Tendons are firmly fasten'd to the common Tendon of the Heart for their Support. The Fibres composing these two Auricles wind about 'em, and terminate in the common Tendon opposite to their Origination. The right Auricle is softer, and, like the right Ventricle, seemingly larger than the left, which is stronger and more compact than the right. Their Cavities are unequal like those of the Ventricles, having Furrows, which in the left are more in Number, and deeper than in the right. They have also several fibrous Pillars, which cross one another, terminating in their proper Tendons. The Auricles, as well as the Ventricles, have their *Systoles* and *Diastoles*, but alternately; the Auricles receiving their Blood from the Veins, while the Ventricles throw their Blood into the Arteries. They have their Arteries from the *Coronariæ*, which are by some call'd *Arteriæ Auriculares*. These bring the Blood for their constant Nutrition, and the *Residuum* is remanded back into the *Cava* by the Coronary Veins. They have their Nerves from the *Par Vagum*. They have Lymphaticks, which discharge themselves into the *Thoracick Duct*. [See Fig. 1, 2, 4, 5. Plate 1.]

THE *Vena Cava* has several reddish and fleshy Fibres, which surround its Trunk near its Entrance into the right Ventricle, and the same Sort of Fibres are found at the Root of the *Vena Pulmonalis* near its Entrance into the Left.

NEAR the Union of the *Vena Cava ascendens* and *descendens*, is an *Isthmus*, commonly call'd *Tuberculum Loweri*. [See Fig. 2. Plate 1.] This Protuberance is made by a Production of the Coats of these two Vessels, and directs the Blood of each into the right Auricle. In Beasts, whose Position is Horizontal, this Protuberance is not so visible; only the Vessels have a little Bent by way of Direction to the right Auricle.

IN the *Cava*, just opposite to the *Cava ascendens* near the *Isthmus*, is the *Foramen Ovale*, which is always found in *Fœtus's*. This Hole opens into the *Vena Pulmonalis*, on which Side it has a Valve which hinders its Return back again. [See Fig. 2. Plate 1.]

THERE is likewise another Duct or Canal in *Fœtus's*, which rises from the Pulmonary Artery and runs into the *Aorta*. This Conduit is call'd *Ductus*, or *Canalis Arteriosus*, and degenerates into a Ligament soon after the Child is born, the Blood circulating then thro' the Lungs.

THE *Aorta* and the *Arteria Pulmonalis* have three similar Valves, call'd *Sigmoidales*, because they resemble the Greek Letter *Sigma*, which was anciently written like our C. These Valves are likewise call'd *Semilunares*, from their Likeness to an Half-moon. These Valves are of a membranous Substance, and spring circularly from the Tendons of the Heart. Each Valve is convex on its Side next the Heart, and concave on the other, by which extraordinary Contrivance they are more peculiarly useful for the End which Nature design'd them. For tho' they have not the additional Supports which the *Mitiales* and *Tricuspides* have, yet they sufficiently perform their Office as Valves. A very perfect Idea of the Use and Office of all these Valves may be had by injecting of Water thro' the *Ostium*, or the Cone of the Heart: or pressing the Cone when the Heart is half full of Water. [See Fig. 3, 4, 5. Plate 1.]

HERE I finish this Lecture upon the Anatomy of the Heart, having describ'd every constituent Part thereof as justly and minutely as I could. I have designedly omitted giving or assigning any particular Use of those Parts, especially the muscular Fibres: First, because these will naturally explain and illustrate themselves in describing how the Circulation of the Blood is perform'd; and, secondly, to avoid as much as I possibly could

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Tautology, being under an unavoidable Necessity to repeat 'em in my next Lecture ; which will be upon the Nature and Origin of that Fluid call'd Blood, with its proper Vessels of Conveyance, by way of Introduction ; the better to demonstrate how the Circulation of the Blood is perform'd by the Machinery of the Heart, through the Veins and Arteries in an Human Body.



LECTURE



LECTURE II.

THE Blood is an heterogeneous Fluid, composed from the various Particles of Animals and Vegetables, which are our constant and daily Food. Nay, even those very Animals and Vegetables are again compounded, participating more or less of their native Soil and Nourishment.

THE very Water which we drink is compounded, receiving several Particles from the different Earths it passes through: Nor are the Aliments only compounded in themselves, but even again undergo more Changes from their Entrance in at the Mouth, to their mixing with the Blood in the Subclavian Vein. Now the Blood having its constant supplies from these Aliments, 'twill be proper to shew how they are prepar'd and fitted for this necessary Purpose: which is thus.

IN the Mouth they are chew'd, when the Muscles, employ'd in Mastication, pressing upon the neighbouring Glands, squeeze out the *Saliva*, which mixes with the Aliments, and moistens them sufficiently to be swallow'd down into the Stomach; which is perform'd by proper Muscles thro' the Gullet, whose longitudinal and circular Fibres convey them quite down thro' the Superior Orifice of the Stomach.

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THE Aliments being arry'd here, they receive a fresh Supply of Liquor to dilute them, from the glandular Coat of the Stomach, which is innermost. Then the third Coat, which lies between the nervous one and fourth, which is a Production of the *Peritonæum*, compresses this Mass according to the Direction of the Fibres, which run partly in straight Lines from the upper Orifice to the *Pylorus*, and partly in circular ones from the upper Part to the Bottom of the Stomach obliquely.

THUS the Cohæsion of all the *Moleculæ* of the Aliments, by a Force nearly equal to 250734 Pound Weight, and with the Assistance of the inhærent Air, is broke: And the Aliments, being so far digested, are, by the said Force, expell'd the Stomach through the *Pylorus* into the *Duodenum*. Afterwards the straight-lined and spiral Fibres of the second Coat of the Intestines (forming a Motion call'd *Peristaltick*, or *Vermicular*) drive the said digested Aliments down to the lower End of the *Duodenum*, where they meet with another Liquor, call'd *Bile*.

THIS *Bile* is a Juice separated from the glandular Substance of the Liver, and deposited in the *Vesicula Fellis*, or Gall-bladder, by an infinite Number of biliary Ducts. Now, the Stomach being distended with Food more or less, proportionably squeezes this Bladder, whence the *Bile* flows through the *Ductus communis Choliodochus* into the Place aforesaid.

ADJOINING to this, or very near, opens the *Ductus Pancreaticus Virtsgungi*, which brings another Liquor, which is prepar'd in the *Pancreas*, being a Gland of the conglomerate Kind. Here the two Juices blend with the chylous Substance descending from the Stomach, where by the Fluidity of the one, and the Acrimony of the other, their little *Moleculæ* are farther diluted and broken. The *Impetus* of the Peristaltick Motion, and the Pressure of the Midriff, and the Muscles of the lower Belly, force the finer Parts of the Chyle, so prepar'd, thro' the *Papillæ Intestinorum*,

rum, which lay on the innermost Tunick of the Intestines in the upper Side of the *Valvulae Conniventes*.

PEQUET calls this Tunick, or Lining, a spungy *Peristoma*. *Bilsius* calls it a woolly Moss. And *Willis*, *Glandulosa*, or *Tunica villosa Intestinorum*. Thro' these *Papillæ* the *Chyle* is percolated, when 'tis receiv'd by a Multitude of capillary Tubes issuing out of the small Guts. These capillary Tubes uniting soon after, form larger Branches, call'd, *Vene Laetææ primi generis*, and carry the *Chyle* to the Glands of the Mesentery, partly by the Force communicated as aforesaid, and partly from a *Lympha*, which is secreted from the capillary Arteries of the Guts continually running thro' these fine Canals; which Stream both dilutes, and drives the *Chyle* along with it thro' the lacteal Vessels, to prevent its Obstruction, which would be of fatal Consequence to the Individual.

FROM these Vesicular Cells the *Chyle* is carried by Lacteals of a larger Diameter, call'd *Laetææ secundi generis*, to the *Receptaculum Chyli*.

EUSTACHIUS was the very first that discover'd the Lacteals, but never knew their Use. Next *Astellius* discover'd them above an hundred Years ago, imagining they convey'd the *Chyle* to the Liver, (the supposed Fountain of Sanguification.)

THE *Receptaculum Chyli*, with the *Ductus Thoracicus*, were found out by *Pequet* almost eighty Years ago. This Receptacle lies under the descending Trunk of the *Aorta*, and the *Vertebræ* of the Loins. Its greatest Diameter is between the cæliack and emulgent Arteries, and environ'd by a great many vesicular Glands, viz. the *Glandulæ Lumbares*. These Glands, with those of the *Abdomen* and Legs, send a large Quantity of *Lympha* again to dilute, and with the Pulsations of those neighbouring Arteries press the Bag constantly to propel the *Chyle* into the Thoracick Duct.

THIS Tube has several Valves at proper Distances, and runs up on the left side of the *Thorax*, under the *Aorta descendens*, along the *Vertebræ*. The Valves, which are concave upwards, resist the *Chyle's* returning down again. Therefore when this Liquor, contain'd in the intermediate Spaces between the Valves, is squeez'd by the Vibration of the said *Aorta*, &c. and not finding a Passage down again, from the Resistance of the inferior Valve, forces itself thro' the yielding superior one; and so by degrees climbs up to the left subclavian Vein, into which it opens with one, sometimes two Orifices.

ON the Inside of this Vein are two semi-lunar Valves, covering these Orifices; and fastened so, that the Current of the refluent Blood may gently slide over them. By this Orifice neither the Blood can enter the Duct, nor gravitate upon the *Chyle* to prevent its Ascent; and here it is that it enters the Blood, and with it assimilates by gradual Circulations.

HENCE 'tis evident, that the *Chyle* being a Compound, the Blood must be so too; since the first is not only the *Pabulum*, but the very *Materia prima* of the latter.

I have been thus particular upon the *Chyle* for several Reasons, which will sufficiently appear in this and the ensuing Lecture.

THE Vessels which the Blood passes thro' are the Arteries and Veins. The Arteries carry the Blood from the Heart, and the Veins bring it back again. The Arteries are conical Tubes, whose common Base springs from the left Ventricle of the Heart, and their *Apex* at their Evanescence into Veins, which Veins are inverted Arteries. The *Apex* of every Vein is at its *Anastomosis* with the *Apex* of the Arteries, and their common Base opens into the right Ventricle of the Heart.

THE Arteries have three Coats; the first of these is a fine Net-work of Veins, Nerves and Arteries, which are very curiously wove into each other, and run into the other two, particularly the second, to nourish and invigorate them with Blood and animal Spirits. The second Coat is made of several *Strata* of spiral Fibres, springing from the Tendon of the *Aorta* in the Left Ventricle, winding very closely towards the *Apex*, or Evanescence; and continued to form the Vein in the same Manner, till they are inserted into the Tendon of the right Ventricle.

AS the Artery is the thickest where its Diameter is greatest, so the Thickness of this Coat is in Proportion to the Number of these *Strata* of muscular Fibres.

THE third Coat is a fine, but strong and diaphanous Membrane. This being innermost, is prodigiously smooth, that the Blood might slide easily and freely along in its Circulation. This Membrane likewise secures the spiral Fibres from separating from one another in the Dilatation of the Artery, and keeps the Blood firmly to its proper Channels.

THE Veins being only a Continuation of the capillary Arteries, their Coats are much the same in a more remiss Degree; only, on the Inside of most of the Veins, which are perpendicular to the Horizon, there are several hollow Valves, whose concave Side is next the Heart.

THESE Valves are the Productions of that fine and transparent Membrane just mentioned; and their Office, like their Figure, is exactly the same with the Valves in the Lacteals.

HAVING explain'd the Structure of the Heart, the Veins and Arteries, and the Fluid from whence the Blood

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is made; I proceed, according to my proposed Method, to shew how the Blood circulates thro' an Human Body.

THE Blood is the Projectile, and the Heart is the *Vis Mōtrix*, or *Primum Mobile* of the Blood's Motion. Now, in order rightly to understand how this Motion is effected by the Heart in the Compound, it will be perfectly necessary to premise a Word or two by way of Explanation of the Nature of those particular constituent Parts which more immediately contribute to this Motion; and those are the Fibres, which compose the Muscular and Tendinous Parts of the Heart.

A Fibre is a Cylindrical Tube made up of a fine and dense Elastick Membrane: which Membrane is again composed of finer Fibres, and so on beyond our Capacity, to analyze and distinguish even with all imaginable Artifice.

A Fibre contains a Fluid, which is separated from the Blood-Vessels and Nerves, to nourish and assist it in its Motion, which is Contraction. For this Fluid being compress'd by the Tension of the containing Part, its Diameter being lessen'd, the Axis is lengthen'd: therefore when the Cause of the Tension is remov'd, the Fibre contracts again, and the Fluid being press'd longitudinally, it increases its Diameter, and consequently stretches the Sides of the Tube circularly; and by this means the Fibre is, in a great measure, assisted in its Contraction.

THAT Fibres do contract, is evidently demonstrable both from the Muscles that have Antagonists, and those that have none. For instance, in those that have no Antagonists, as the Stomach, which always contracts till the Digestion is over, the Uterus and *Vesica*, with all the *Sphincters*, contract immediately after their Tension and the Cause of it is discharg'd. In Muscles which have Antagonists, upon dividing of one, the other contracts immediately, and the two Segments of the

Muscle so divided, retire, one to its Insertion, and the other to its Origination.

THE REFORE, as every muscular Fibre contracts naturally of itself, as soon as the Force which distended it ceases; the Circulation of the Blood through the Heart will appear very plain.

TO begin with the Right Side of the Heart: Let us suppose the refluent Blood just ready to enter the right Auricle, which Auricle we will likewise suppose to be in its *Systole*: now, as the Venal Blood moves constantly, tho' slowly, the *Cava*, at its entrance into the said Auricle, must of consequence swell by an accumulation of the refluent Blood, whilst the Auricle is in its *Systole*. The *Systole* being over, the *Diastole* instantly succeeds it; when the tendinous Circle opens, which, like a *Sphincter*, had tied up the Mouth of the Ventricle so closely during the *Systole*, that not one Drop of Blood could either enter in, or return into the *Cava*.

THE Auricle being now in its *Diastole*, the accumulated Blood in the *Cava* rushes into the Auricle partly by its own impress'd Motion, and partly by the Contraction of those fleshy Fibres which surround the Trunk of the *Cava* at its entrance into the right Auricle.

THUS the *Cava* has its *Systoles* and *Diastoles* alternately with the right Auricle, tho' but very faint ones in comparison. By this contrivance, the slow Motion of the venal Blood is accelerated, and consequently springs with a greater Force into the contracted Auricle: Thus it is more effectually and sooner distended; and, therefore, must necessarily both contract with more Force, and a greater Celerity: Re-action being always equal to Action both in Time and Force.

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THIS Contraction is performed by the two Orders of oblique prismatick Fibres, which decussate each other in their Construction of the Auricle. Now, all Muscles contracting according to the Direction of their Fibres from their Origin to their Insertion; the strongest Contraction will be always in that part of the Fibre which is the farthest from its fix'd Points. For Example, a Chord extended between two fix'd Points, and vibrated, the greatest Vibrations will be always found in the middle of the said Chord, and consequently the most forcible. Therefore I conclude, that the Blood in all the Cavities of the Heart receives the greatest Impulse at the greatest Distance from, and lesser proportionably as it approximates, or comes nearer to the Tendons which surround the Mouths of these Cavities. This Contrivance prevents any the least drop of Blood from being left behind in the *Systole*. For had the Vibrations been less quick in the bottom than they are, some of the Blood might have been left behind, from a too sudden Contraction of the Fibres about the Mouth of the Cavity.

BUT another very extraordinary good Effect ensues upon this: for the principal Design of this Muscular Contraction was not only to drive out the Blood, but to give it a force proportionable to the Rout it was to take, namely, by a strong Impulse from behind. Hence it is evident, that the Blood is propell'd out of the Cavities of the Heart by a compounded Motion, *viz.* by a circular and direct, or straight-lined Impulse.

BUT to return to the Right Auricle.

IN its *Systole* it propels the Blood into the Right Ventricle, which is in its *Diastole* then; into which Ventricle the Blood still rushes till it is sufficiently dilated, and then succeeds the *Systole*; which is thus.

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THE right-lined Fibres, which run from the Tendon of this Ventricle, and from the Side of the Pulmonary Artery, and are inserted in the Apex, shorten the Heart when they contract; and the two *Rhomboïdales* decussating each other, and winding spirally, contract accordingly. The *Penniformes* likewise, which spring from each side of the Pulmonary Artery to be inserted on one side to the Tendon of the *Aorta*, and to the Tendon of the right Ventricle on the other, contracting, dilate the Mouth of the Pulmonary Artery. The Fibres likewise which it receives from the *Septum*, with those which it has in common with the left Ventricle, jointly contracting, expel the Blood thro' the Pulmonary Artery into the Lungs. In the *Systole*, the Communication between the right Ventricle and Auricle, is entirely cut off by the *Valvulae Tricuspides*, which is thus:

THE *Papillæ* in the Contraction, when the Heart is considerably shorten'd, relaxing the Valves, fly up and stop the Passage where they are supported by the tendinous Strings before described, which terminate in the Tip of their Angles. But when the Heart is in its *Diastole* again, it lengthens, and draws the Valves back again by the tendinous Strings, to give admittance to the Blood from the right Auricle.

THE Blood being now got by the *Valvulae Semilunares*, they oppose its return the same way again by their concave Sides, like Water-Gates: And the *Vis impressa* from the right Ventricle, forces it thro' the small Branches of the Pulmonary Artery, which are join'd to the Branches of the *Vena Pulmonalis* by *Anastomoses*. The small Branches of these Vessels are interspersed quite thro' the whole Substance of the Lungs running along the Sides of the *Bronchi*, and the little Lobes of the Orbicular Vesicles.

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HERE, by the Gravitation of the Air, which is commonly reckoned to be equal to an hundred Pound weight, the Blood is compressed, and its Motion proportionably accelerated. The grumous Particles are very much broke, and consequently the whole Mass, by this Contrivance, must be made more fluid, and as it were, refitted for its next Voyage round the Microcosm.

NOW as the Air, rushing into the Lungs by the *Trachea Arteria*, ventilates and gives a Passage to the Blood into the Branches of the *Arteria Pulmonalis*: so upon Expiration, or the Exit of the Air, the Cavity of the Thorax is contracted by its proper Muscles, and the Blood, by the Pressure of the Lungs upon its Vessels, is forcibly repelled through the *Vena Pulmonalis* into the left Auricle.

AT the Entrance of this Vein, there are likewise a great many fleshy muscular Fibres as a check upon the too great Redundancy of the accumulating Blood, while the left Auricle is, as I observed before of the right Auricle, in its *Systole*: When the Blood has entered the Auricle, it is thrown into the left Ventricle, which was then in its *Diastole*; the tendinous Circle round the Mouth of the Auricle contracting, and so preventing the Blood's return back again to the pulmonary Vein during its *Systole*. When the left Ventricle contracts, the *Papillæ* relaxing, as in the right Ventricle, the *Valvulae Mitrales* spring up into the Passage where the Blood enter'd to prevent its return into the right Auricle again.

NOW as the Blood which is sent hence through all the Arteries to every the remotest Part of the Body must have a Force proportionable to those Distances, so Nature has contrived its Strength accordingly, being considerably thicker, and having more Plans of Fibres surrounding its Cavity, than the right Ventricle. The *Septum* likewise, which makes up a Part of this Ventricle being very strong and compact, sends off

a great many Fibres, which surround and embrace it from Top to Bottom. Now, when all these act together, the Force is wonderfully augmented. The straight Fibres, which run from the Tendon of the *Septum*, being very numerous and terminating in the *Apex*, contract and shorten the *Axis* of the Heart, dashing as it were the Tip of the Heart against the *Fundus* of this Cavity with the greatest and most visible Vibrations of any, whilst the Spiral Fibres pressing laterally, the Blood is totally expelled, and the Insides closely compressed by the means of a great many deep Furrows, which are in this and all the Cavities of the Heart, being deeper, and more in Number in Proportion to the Strength of their respective constituent Parts.

THE Blood being thrown into the *Aorta* with so great a Celerity, it must necessarily press with a proportionable Force against the Sides of this and every Artery circularly, as it moves along: till the spiral Fibres which compose their second Coat, contract and compress the Blood back again from the Circumference to the Center. But as the Sides of the Arteries converge or incline nearer one another, as they move along, the Blood will be driven more obliquely to the internal Circumference of the Tube in the *Diasbole*, and more obliquely *vice versa* in the *Systole*. And thus is the arterial Blood driven by a compounded and an intestine Motion to the Evanescence of the Arteries, or their Inosculation with the capillary Veins, (the *Valvulae Sigmoidales*, which are fastened on the Tendon where the *Aorta* begins, preventing the Blood from being Retrograde.)

IT is to be observed by the way, that the Evanescence of an Artery does not always terminate in and immediately communicate with a capillary Vein. The *Arteria Cœliaca* running into the Spleen, discharges its Blood through the capillary Branches into an infinite Number of membranous Cells or Cavities, which communicate with one another, being different

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rent in Figure and Bignes. From these Cells the Blood is carry'd back again by the capillary Veins of the *Ramus Splenicus*. The Circulation of the Blood through the Brain is the same. The Carotyde Arteries discharge the Blood in the several *Sinus's* which is brought back by the jugular Veins, their capillary Branches communicating with the said *Sinus's*. But to return.

WHEN the Blood is got into the Veins, it moves slow, but constantly, which in the Arteries moves *per saltum*. In the Veins there is no sensible Pulse, the Blood moving by gradual Climaxes, which are Valves. These Valves are like the Halfs of Acorn Cups placed circularly on the Inside of the Veins at certain Distances, with their Cavities towards the Heart. Thus the communicated Motion of the Blood from the Arteries ascends the Summit of the first Valves which suspend it, and prevent its Gravitation upon the next that follows; this next presses against the Valves which supported the first, and drives it to the next Valves, and so the Blood moves on in a progressive Motion till it reaches the right Ventricle of the Heart again. This progressive Motion from another Contrivance is very much facilitated, viz. from the diverging of the Sides of the Vein from the Fluid; and again the contiguous Muscles pressing upon the Veins, add to this Motion in the very same manner mentioned of the Chyle in its Ascent thro' the Lacteals and Thoracick Duct.

THUS all the reflucent Blood from the Head and Arms, is brought by the *Cava Ascendens*, and from the rest of the Body by the *Cava Descendens*. Near the Union of these two great Veins there is a Protuberance called *Tuberculum Loweri*, which directs the Streams of these Vessels, and at the same time supports the Weight of the descending Blood from falling counter to the ascending, which would otherwise stop the Circulation.

IN *Fætus's*, the Circulation differs from what I have already explain'd, in this particular : The Lungs having never been distended with Air, lie heavily press'd together, so that the Blood cannot freely pass from the right Auricle to the left by the Pulmonary Vein and Artery ; therefore it must have another Rout, which is thus :

THE Blood being brought from the *Placenta* by the Umbilical Vein into the *Vena Portæ*, it passes by a straight Canal into the *Cava*, and so is carry'd thro' the *Foramen Ovale* into the *Vena Pulmonalis*, for the Reason aforesaid ; thence into the left Auricle, afterwards into the left Ventricle, whence 'tis dispersed over the whole Embryon by the Pulsation of the Arteries. The Blood, which is brought by the *Vena Cava descendens*, being diverted from falling upon the *Foramen Ovale*, empties itself into the right Auricle : thence 'tis thrust into the right Ventricle, whence the greatest part is carried by the *Canalis Arteriosus*, which goes from the *Arteria Pulmonalis* to the *Aorta*, the Blood-Vessels being too much compress'd by the weight of the Lungs for the admittance of the whole. The superabundant Blood is return'd by the two Umbilical Arteries into the *Placenta*, where 'tis receiv'd by the Veins of the Mother ; and so there is a continual Circulation of Blood carry'd on from the Mother to the Child, and *vice versa*.

I shall finish this Lecture with an account how the right Auricle and Ventricle come to be apparently bigger than the left. I observ'd before, that the Organs thro' which the Blood passes, are thicker and stronger in proportion to the Force and Celerity of that Fluid : Therefore it is absolutely necessary that some of these containing Parts should have their apparent Bigness almost equal to their real Content, and others apparently less, (all Fibres contracting and resisting more or less, as their numbers are.) Now the venal Blood in the *Cava* being

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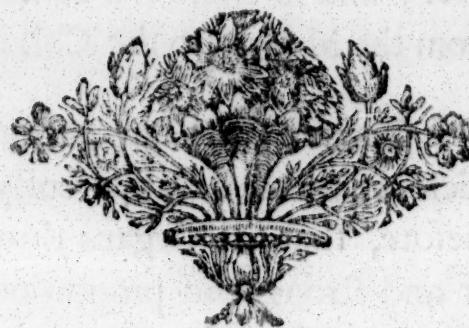
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flow, its Impetus against the Sides of the Auricle must consequently be very weak, and but just sufficient to fill, and gently to dilate it: whereas after the Blood has passed the Lungs, it becomes more fluid, and its Motion accelerated to a great degree. Thus it must dilate the left Auricle proportionably, that the whole Content of Blood from the right Ventricle may be exactly compress'd in the left. For had the Content of the right Ear been really greater, as it is in appearance, in every *Systole* of the Heart, the Blood would have accumulated more or less, till the Blood-Vessels had burst to pieces in the Lungs; the times of Contraction and Dilatation both in the Auricles and Ventricles being equal: Therefore it necessarily follows, that all the Cavities of the Heart must be equal in Content, tho' the Cavities on the right Side are apparently bigger than the left. Hence likewise we must conclude, that if by an Accident the Right Auricle takes in more or less Blood than usual, the other Cavities, must receive the same quantity (still supposing the Blood in a natural State) in their *Diastoles*; for in every *Systole*, the Cavity is entirely emptied, and sent on to the next, till it enters the *Aorta*.



LECTURE



LECTURE III.

HA VING describ'd the Heart, and the Nature and Circulation of the Blood in their natural State, I shall first proceed to shew, in this LECTURE, how, and by what Gradations this Fluid may be affected in its Circulation, thence to account for the various Phænomena in a præternatural one. And afterwards I shall propose a Method of Cure, in order to regulate this Disorder, by removing the Cause (where the nature of the Distemper will admit of it) and to restore the vitiated Organs to their just and natural Functions, and the Blood to its due Crasis again.

NOW the whole Machinary of an Human Body consisting of the nicest Symmetry and Proportion of its Parts, it must necessarily follow, that a very slight Indisposition in one place will, more or less, affect the rest; so mutual is their Dependence one upon another. For Instance,

THE Blood is generated from the Chyle, and the Chyle is assisted by the Vibrations of the Arteries. The animal Spirits are made from the finest Parts of the Blood, and elaborated in the Glandular Substance of the Brain and *Medulla Spinalis*, from whence they flow by their proper Canals, the Nerves, to give Motion to the Solids. The Solids drive on the Blood, and the Blood accelerates the animal Spirits in their Circulation; and so on for all the Fluids, and their containing Solids.

BUT to return: The Blood being a Compound of Corpuscles, which are very different in respect of their specifick Gravities, it naturally follows, that these Corpuscles, the nearer they approach to rest, will the more easily separate, (the heavier subsiding, and the lighter ones emerging.)

BUT as the Heat of the Blood depends upon the Briskness of its Circulation, so does this Separation depend upon the greater or less Remissness of the Heat of the Blood; for 'tis well known, that extravasated Blood condenses and coagulates soonest, where the Intenseness of the Cold is greatest. Therefore, the greater the Languor of the Blood is, the greater will be the Diminution of its Heat, and consequently will be render'd more liable to run into Grumes, or little concreted Clots. Thus the Blood becomes less fit for passing the fine Capillary Arteries, and, by being retarded too long and too often, a total Obstruction will inevitably ensue, attended with universal Convulsions, and a trembling and irregular Pulsation of all the Arteries in general.

THIS Languor, or ill Crasis of the Blood, is generally caus'd by some of these following Circumstances, viz. First, either by some malignant Particles casually mixing with the Blood: Or, Secondly, by some adventitious *Plethora*: Or, Thirdly, by some Disorder in the Solids, whereby their Tone and Office

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is so far hurt or impair'd, as to affect the Circulation, and consequently the whole animal Oeconomy. And,

FIRST, Experience, and daily Observation, tell us, that such Accidents happen almost continually from malignant Particles mixing with the Blood. For Example, in the Small-Pox, in pestilential Fevers, from the Biting of poisonous and enraged Animals, from the Nature and Quality of several Drugs, &c. From these Causes, I say, and such like, the whole Mass has been alter'd and vitiated to such an extraordinary Degree, that coagulated Blood has been commonly found in the very Ventricles of the Heart, when such Subjects have been open'd. The Coagulation of the Blood is ocularly demonstrable, by injecting three or four Ounces of Vinegar into the Jugular-Vein of a living Dog. Immediately after this Operation, a few Convulsions intervening, the Dog expires, and if his Thorax is laid open, that moment you will find all the Blood in the Sinus's of the Heart fixed and congealed. This Phænomenon is easily accounted for, by considering that the Blood is only an assimilated or modified Chyle, or milky Fluid, warm, and in Motion, which will naturally curdle upon mixing with so potent an Acid.

HENCE 'tis evident, that dissimilar and disagreeing Particles communicating with the Blood, will vitiate its Crasis in a Space of Time proportionable to the Strength of the said Particles, and that of the Patient. Again,

THE Coagulation of the Blood is very aptly illustrated by several curious Experiments in natural Philosophy, particularly by the following ones, viz.

POUR Spirit of Salt upon the White of an Egg, and in a very little time a Coagulation will ensue. Again, if you mix good Spirit of Wine with an equal Quantity of the Spirit of

Salt

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Sal Armoniac with the Salt of Tartar newly prepared; or Spirit of Wine with an equal Quantity of pure Spirit of Urine well shook together in a Glass-Bottle, they will quickly coagulate, and become a pretty hard Mass.

NOW, if Fluids, so simple and uncompounded as the White of an Egg, and so fine and volatile as Spirit of Wine, can be coagulated and fixed by these Spirits of Salt, two of which are animal Salts, viz. the *Sal Armoniac* and the Spirit of Urine, it is easy enough to conceive how the venomous Salts of Animals, or any pernicious Particles, blending with the circulating Blood, which is so compounded a Fluid, as observed before, must coagulate it, and that more or less in proportion to the Quantity and Quality of these Particles so entering, and consequently must induce a Languor, or an unnatural *Diatheſis* of the Blood.

SECONDLY, A *Plethora* will do the same: For when the Increase is greater than the Decrease, the Volume of the Blood must necessarily be augmented, and the containing Vessels be stretch'd beyond their natural Size.

NOW, a *Plethora* may happen several ways: For Instance, First, from too violent Exercise. Thus the Muscles and their Tendons being forcibly agitated, vibrate against the Sides of the adjacent and contiguous Blood-Vessels, and consequently must drive on the Blood with a greater Impetus. Thus the Blood is render'd both more fluid and more hot, (Heat being the Effect of Motion) and the Pulse beats quicker and higher. By this means the Blood being broke and comminuted by an adventitious Heat and Motion, must, like the tinged Spirit in the Thermometer, take up a greater Space, and consequently distend the containing Vessels beyond their natural Size. Hence comes that Faintness and Weakness from a greater Consumption of the animal Spirits than their secreting Glands

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can supply; hence comes that violent Thirst, and panting for Breath, the distended Veins and Arteries pressing the *Bronchi* and orbicular Vessels unnaturally, obstruct the free Respiration of the Lungs; and hence, too often Death ensues, the common Consequence of a too great Rarefaction of the Blood, when the Fibres must necessarily lose their contractile Force, and the Fluid, by degrees, its Motion.

FOR tho' a muscular Fibre naturally contracts again after its being dilated, (the Force abating) yet, like a Bow too much bent, and too long kept in that position, they lose their elastick Force when over-strain'd, and by being continually over-loaden, intirely lose their Motion, and by degrees their very Nature too. Hence it is that the *Canalis Arteriosus*, and the two Umbilical Arteries are metamorphosed into strong Ligaments: Hence some of the Arteries and Tendons have been ossify'd; hence several Muscles have been extended to a monstrous degree, as is evidently seen in an *Ascites*, &c. For as Motion, and a proper and sufficient Moisture, is necessary to preserve the very nature of a Fibre, so too little Motion alters its Contexture; and too much Moisture, whose viscid Cohesions clogging the fibrile *Mackinulae*, and very often totally damming up the *Vacuola* between the transverse Surfaces, destroys its *Vis Restituendi*: And thus the Impression upon a part, affected with an *Anasarca*, &c. remains a great while after.

FROM hence it is very easy and natural to account for the surprising Bigness of the Auricles, when a *Polyphus* grows in either Ventricle. I shall mention one particular Instance, and that is that of a Lady of Quality, as it was communicated to me by a worthy Fellow of this COLLEGE. The Case is this:

UPON opening the *Thorax*, the Heart was found three times bigger than the usual Size, and the *Vena Cava* extended

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in proportion, and the right Auricle was dilated near twelve Inches in length, and five in breadth, and when open'd, it contain'd at least two Pounds of Blood very much coagulated, and some of it concreted into solid Cakes, resembling a true *Polypus*. In the right Ventricle was likewise a great deal of coagulated Blood, and a large white fleshy *Polypus*, which was five Inches long, and above an Inch broad, and half an Inch thick. The left Ventricle was much the same with the right, the *Polypus* excepted; and the left Auricle was much less than ordinary, and the Liver vastly large. There are a great many more Particulars; but this being enough to the present purpose, I shall omit the rest.

NOW to account for these Phænomena, and all others like them, it is to be understood, that a *Polypus*, or *Sarcoma*, being a præternatural fleshy Excrecence, and receiving Nourishment from its proper Vessels, must necessarily grow still bigger and bigger. Now, when such an Accident happens, as in the Case above, it must in proportion to its Bulk, not only retard the Exit of the Blood, but likewise hinder a great deal of the Blood from being driven out by interfering and preventing the Sides from coming close together in the *Systole* of the Ventricle, where it grows.

NOW the Auricles always contracting and dilating alternately with the Ventricles, it must necessarily follow, that the Quantity of Blood received by the Auricle in its *Diastole*, cannot be all thrown out in its *Systole* into the Ventricle, for the reason aforesaid; but the refluent Blood still endeavouring to force itself into the Auricle, when in its *Diastole*, both the Auricle and the *Vena Cava* must be prodigiously extended, all Fibres gradually yielding to a superiour Force. Again, the Blood being so long retarded, must naturally coagulate, for a reason aforesaid; and the left Auricle must certainly grow less than ordinary, because in such a case as this is, neither the

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Quantity nor Force of the Blood were sufficient to keep it distended to its natural Size; all containing fibrous Parts contracting or distending in proportion to the Force and Quantity of their Contents, as I observed before of the *Canalis Arteriosus*, &c. The Largeness of the Liver must be occasion'd by the accumulating Blood distending the Branches of the *Vena Portæ*, and the *Vena Cava* likewise; the Circulation being so much retarded by the *Polypus* in the right Ventricle.

THE *Polypus* in the Heart, and Extension of the Auries, &c. to such a surprising Bulk, are Maladies not to be come at by the Surgeon, and consequently incurable; for Medicines have no Power in such a case. But to return:

A *Plethora* will happen from a too great Influx of Chyle upon an extravagant Debauch of eating or drinking, which is commonly call'd a Surfeit. Hence come violent Head-Achs, Deliriums, Lethargys, Coma's, Epilepsys, Apoplexys, and all the black List of Distempers, which affect the Brain, Nerves, and all the contiguous and continuous Parts of the Head; the Eyes, the Ears, the Tongue, &c.

NOW, when the Stomach is so overcharged, the Fibres, if at all, can but slowly contract, (let the Aliments be of ever so easy a Digestion) and consequently but slowly expel the solid part of the Debauch; the Blood-Vessels therefore must be almost burst before the Stomach can be half emptied, the more spirituous and fluid Parts flying off first, and creeping thro' the Lacteals into the Blood. Now the Volume of the Blood being so hastily increased and thinn'd by the Sprightliness of the Liquors, which always in such a case happens before the Stomach is half emptied, (unless by a violent Fit of Vomiting) their greatest Force and Effects are upon the Head and superiour Parts; because the heavy and extended Stomach must necessarily press upon the descending *Aorta*, and so pressing,

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must check at least the descending Blood, and so its greatest Quantity and Force must and will be turned thro' the *Carotides* and Vertebral Arteries into the Head.

NOW 'tis easy and natural to conceive that the Arteries must unavoidably be distended by so violent a Force and Quantity of Blood, and consequently all the *Sinus's* of the Head; by this means the whole Substance of the Brain must be compress'd, and consequently all the Glands, with their excretory Ducts, the Nerves, must be so too. Hence proceed all those Ravages afore-mention'd, with a great many more: for it is from these Glands, and through these Ducts, that the Animal Spirits spring and flow. Upon these depend the Being of the whole Animal OEcconomy; they give Motion, and Sensation, and Nutrition to every part.

NOW these being separated from the finest part of the Blood, as I obsery'd before, a proper *Diatheſis* is absolutely necessary in the Blood; but in all *Plethora's*, and particularly in this, both their Secretion and Motion must be impeded: for a Gland being only so many Circumvolutions of a fine tubous Canal, and their excretory Ducts so many almost right-lined Tubes, their Sides must be compress'd, and consequently render'd very uncapable of their proper Office, by their concomitant Parts being distended and distorted beyond their natural Size and Situation.

HENCE we must derive the Cause why the very Muscles become flaccid and motionless, which in a natural State are quite the reverse: for 'tis the self-same Juice which both fills the tubous Fibres, and likewise gives them Motion, as is evidently seen in a *Paralysis*, where, from the want of this Juice, the Parts are emaciated, and become void of Sense, and Motion, and Strength.

FOR

FOR this Juice being brought here, 'tis certain, it does not stay and stagnate here; Corruption being inconsistent with a natural State: therefore it must have its proper Vessels to return it somewhere after it has done its part, it being as impossible to return in the same Vessel that brought it, as it was to come here without one.

AGAIN, it is certain, that all the Muscles become stronger by their being the oftener moderately exercized. Thus the right Hand and Arm are generally stronger than the left, because more generally made use of.

NOW, as Strength immediately depends upon constant Supplies of Nourishment, I conclude that the Fibres of all Muscles in exercise, must, from their Contraction and Dilatation, compress their contain'd Fluid both laterally and longitudinally, and consequently expel some part of it by its excretory Canals, to make room for a fresh recruit of animal Spirits through their proper Vessels of Conveyance, the Nerves.

THUS the Heart is constantly maintain'd and invigorated, and its involuntary and incessant Motion kept constant, Accidents excepted, sometimes above a hundred Years. This is very aptly confirm'd by the Distribution of the Nerves in the Substance of the Heart, they running in at the Base in greater plenty near the *Aorta*, where the Motion is the strongest, and the Fibres most numerous, and *vice versa*.

FROM hence 'tis demonstrable how Exercise becomes so salutary, especially such as more generally vibrates the whole System of the Muscles moderately; and in this case, Musick too is extremely Useful and Necessary: For it is by this means, that the stagnating Spirits are lash'd on, and circulate freely;

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which gives Clearfulness to the Mind, and renders the Body lightsome, active, and strong.

ON the other hand, 'tis as demonstrable how those miserable Wretches, who are pamper'd and debauch'd with Luxury and crippled by an unactive, lazy way of Life, become Sacrifices to a numerous Train of Complaints, as the *Hip, Vapours, Hysterick, Melancholy, Convulsions, Madness, Scurvy, Gout, Dropsy, and Rheumatism*, with a great many more Distempers than I shall name at present. Nay, every Wind that blows, every Change of Weather, as well as every Change of Air, brings a new Disease along with it, and they are never free one Minute, (the Effect necessarily following the Cause :) therefore all a Physician can do with such, who will not leave their beloved, pernicious Customs, is to prescribe at least palliative Medicines, & *valeant quantum valere possint.*

THESE Distempers are unjustly call'd *Opprobria Medicorum*; but the fault is really in the Patient, and not in the Capacity of the Physician: For almost every individual acquir'd Complaint, if taken in time, may be cured, would the Patient undergo a proper Regimen of Diet and Exercise, as well as Physick.

A GAIN, when the Head is compress'd by the *Plethora* aforesaid, Convulsions ensue. Convulsions happen when the circulating Spirits are interrupted, or totally suppress'd. Thus a Blow upon the Elbow, between the Protuberance of the *Os Humeri* and *Ulna* stuns and convulses the back part of the Hand and Fingers, particularly the Little and Ring Fingers, where the fourth Branch terminates, which is made from the fourth, fifth, sixth, and seventh Pair of Nerves of the Neck. Again, if you but gently scratch the *Par Vagum*, a little below the *Larynx* of a live Dog, he will vomit instantly; and if you make a strong Ligature upon the *Par Vagum*, he vomits likewise, and dies with strong inward Convulsions upon him: which sufficiently

ciently accounts for Convulsions. Let the Distemper be what it will, this Cause produces the same Effect.

A *Plethora* happens likewise upon the Obstruction of the Glands, and their excretory Ducts. Infinite is the number of Glands in an Human Body, which separate their proper Liquors from the Blood; and are reducible to thirty-seven different sorts, by the most accurate Anatomists. Now, the more general the Obstruction, the quicker is the Blood in a *Plethora*. For Instance, an adventitious Cold obstructing the Miliary Glands of the Skin when the Blood is but moderately rarefy'd, will do this effectually, by putting a stop to insensible Perspiration; which, according to *Sanctorius*, discharges much more than all the sensible Evacuations put together. Therefore the Blood, being depriv'd of so great an Evacuation, must necessarily be prodigiously increased in a very little time, and the Patient thrown into a Fever. The other Glands are obstructed from an ill Crais of the Blood, which is generally the Effect of these *Plethora's*, and give the Distemper a Name peculiar to the Obstruction of the Gland or Glands so affected.

THIRDLY, The Crais of the Blood is very often vitiated from some Disorder in the Solids, whereby the Tone and Office of their compounding *Fibrillæ*, are so far hurt and impair'd, as to affect its Circulation, and consequently the whole animal OEconomy at the same time.

I have observ'd before, that the material *Primum Mobile*, or first Mover of the Fluids in an Human Body, and all other Animals, is a Fibre. This therefore being undeniably true, it necessarily follows, that the State and Condition of the Projectiles (the Fluids) and that of the contractile and distractile Fibres will be reciprocal; that is, the Fluids will preserve their natural Property when their vibrating Solids are regular, and *è contra*, they must be vitiated, *viz.* made too thin, or too grofs and fizy,

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sify, when the said Solids are disorder'd either by an Augmentation or Diminution of their natural Elasticity.

HENCE most, if not all hereditary Distempers may be easily enough accounted for, (the Defects of the very Solids in the Parents, being but too commonly and visibly propagated in their Children.)

I shall here dismiss this Article, having all along in these LECTURES had a very particular Eye to the Mechanism of a Fibre, by observing, that the whole Rationale of an Human Body depends upon a nice and adequate Idea of the Tonick Motion of the Solids, and the various Modifications and Properties of their component *Machinulæ*; and consequently every Physician, who would shine in his Profession, must be well acquainted with the Doctrine of a Fibre, in order to make a sure and speedy Alteration in the Constitution of the peccant Fluids.

HAVING thus run over the common and accidental Changes which the Blood is liable to from the Causes above recited, 'tis easy enough to account for the ordinary Symptoms of Fevers in general. For Instance, the Quickness of the Pulse is owing to the Rapidity of the Blood; the *Systole* and *Diaftole* of the Blood being reciprocal in point of Celerity and Time, *i. e.* the quicker a contractile Fibre is dilated, so much sooner it contracts. The Rapidity of the Blood was accounted for before. The intense Thirst and Burning both internally and externally proceeds from the same rapid Motion; and the reason why the Mouth and *Cuticula* are so parch'd, is from an Obstruction of these Ducts and Glands, which should bring a proper Moisture to them. The Irregularity of the Pulse in every respect is owing to accidental Remora's from the *Moleculæ* interrupting the Circulation of the Blood through the Capillary

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Arteries; hence proceeds a Deficiency of Animal Spirits, and consequently Faintness, Convulsions, and, last of all, Death.

THE *Moleculæ* of the Blood obstructed in the Miliary Glands of the Skin, account for the *Petechieæ* of malignant and spotted Fevers, and the difference of their Colour is as their Size and Duration.

THEREFORE, since the Quality of the Blood, in most cases, depends upon its Quantity, or its containing Vessels, or both together, proper Evacuations are absolutely necessary; and, first, Blood-letting is proper, by Cupping, or Leeches, or opening a Vessel with a Lancet. The last Method is best, and answers the End of an Evacuation more *à propos*, than either of the other two; because it is perform'd quicker, considering the Quantity; and the distended Blood-Vessels contract again and recover before a fresh Inundation steals in upon them; which will happen in the other two, the Increase being nearly equal to the Decrease, and consequently the Patient is still but *in statu quo*. Now, a quantity of Blood being remov'd, suitable to the Age and Constitution of the Patient, which is about a fortieth part of the whole Mass, must make a very sudden and sensible Alteration, since Health and Sicknes are so near an Equilibrium in Nature, and that the whole Mass, or a Quantity equal to it, which is 25 Pound, or 400 Ounces, passes the Heart once every six Minutes. Such a Resistance being taken away by this Operation, the Arteries must immediately recover their relaxed State, and their Vibrations will be longer in respect of their Centre of Oscillation, and consequently stronger. Thus the Velocity of the Blood is increased, the Grumous Parts dash'd to pieces, and the remainder of the Mass almost instantly reinstated by this Evacuation, which makes the greatest and surest Revulsion of any.

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II. ANOTHER Evacuation is by *Vesicatory*, from Spanish Flies, whose subtle caustick Salts, separating the *Cuticula* from the *Cutis*, make room for the excretory Ducts of the Cutaneous Glands to empty the *Serum*, which springs from the Blood by their stimulating Quality: for these Salts vellicating the Sides of the containing Vessels, rouze the languid and stagnating Fluids, break their Cohesions, and throw off the peccant Load thro' the Blyster, the Pores, and by Urine, (a due Care being had to prevent a Strangury.) By the assistance of Cantharides, we see the Sick daily redeem'd from the Grave, who must otherwise have inevitably yielded to a hasty Fate.

III. An *Emetick* breaks the Blood, discharges a vast Quantity of Humours by its Vellication of the Fibres of the Stomach. In this Operation, the Liver and the Spleen are prodigiously squeez'd by the Convulsions of the Stomach, and the Muscles of the *Abdomen*. Thus the slow-moving Blood is accelerated, the Intestines and *Mesentery* being press'd, drive on the refluent Blood below; and the Lungs being compress'd by the *Diaphragm* from the convulsive Motion of the Stomach are freed from a tough Flegm. Thus the Blood circulates easier; the Respiration becomes freer; and the certain Consequence is a kind and copious Perspiration. And,

IV. A *Cathartick* operates the same way as an *Emetick*; only this in the Stomach, and that in the Intestines. A *Cathartick*, by twitching the Bowels strongly, increases the Peristaltick or Vermicular Motion from the *Pylorus* downwards: by which means a vast Drain of Humours are carry'd off from the *Mesenterick* Glands: But a great many Particles of a *Cathartick*, stealing through the *Papillæ Intestinorum* into the Blood, irritate the Vessels, and contribute even this way too, to alter and meliorate the whole Mass of Blood both in Quantity and Quality.

THERE

AS there are several Distempers which are the Effects of the ill Crasis of the Blood, so they must be cured accordingly. Thus a *Suppressio Urinae* with proper Diureticks; a *Suppressio Mensium* with stimulating and deobstruent Medicines; and so on.

BUT sometimes it happens that the Glands and their Excretory Ducts are too much dilated by some extraordinary Shock from a *Plethoraick Habit*. Thus first, a *Plethora* affects the Breathing, as I observ'd before, which if not speedily remov'd, affects and ulcerates the very Substance of the Lungs; thence arises a tickling Cough, which increases gradually; thence a praeternatural Agitation of the Blood, as it passes from the right to the left Side of the Heart; thence a slow Fever, which keeps time with the Ulcerated Lungs; and thence immoderate Night-Sweats.

BY the like Gradations we account for the last Stages of a *Diabetes*, when the Urine is as sweet as the Chyle it is produced from, occasion'd from a too great Distension of the Vessels in the Kidneys. Now, to cure these, and such like Complaints, when it is not too late, is by Agglutinants, Astringents, and Balsamicks, &c. of which the *Materia Medica* affords a very plentiful Variety.

HENCE all, or most of the Chronick Diseases derive their Origin, the very Solids warping into an unnatural Situation, as well as the Fluids into Corruption, by too long a Continuance of the first Shock.

A Chronick Distemper is but difficultly cured at best; proper Alteratives being the likeliest Method, with a proper Regimen of Diet and Exercise, with Restoratives in the conclusion. Now the best Restorative (when nothing forbids it) is Cold

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Bathing; for Cold naturally contracts all Fluids, as I observ'd; and when the Blood is so condensed, the Fibres are more at liberty to return again to their natural Tensity: but cold Water contracts the very Solids themselves too, and by degrees restores a languishing and decay'd Constitution, to a miracle. The coagulated Blood will be comminuted, the Animal Spirits spring afresh, a lost Appetite is restored, and all the Functions of Life carried on again with Vigour and Exactness.

I come now to the Conclusion of these LECTURES; and at present shall but cursorily observe to you, that there is but one general and infallible Rule, which is really worthy of a Physician's Observation in the whole Circle of a Rational and Mechanical Practice. The Rule is this, *To adjust and preserve an Aequilibrium between the Solids and the Fluids.*

HOW this is to be done, may in a great measure be deduced from these LECTURES. But if Leisure and Inclination invite me, I may probably, some time or other, explain more fully and more methodically, the various Properties of both the Solids and Fluids, in order to specify and demonstrate this one, and only Rule of Practice, in the different Phænomena of such Distempers as are commonly incident to the whole Race of Mankind.





PLATE I.

FIGURE L.

R Epresents the Heart *in Situ*, with the *Pericardium* stript off.

A. and B. the *Coronary Arteries* running on each side of the Heart from the Basis to the Cone of the Heart. *N.B.* The *Coronary Veins* run in the like manner.

C. The right Auricle.

D. The *Aorta* springing from the left Ventricle of the Heart.

E. The *Aorta descendens*.

F. The right Subclavian Artery.

G. The left Subclavian Artery, with the adjoining left Cervical Artery.

H. H. The right and left *Carotid Arteries*.

I. The left Cervical Artery.

K. The small Arteries running from the *Coronary Arteries* upon the *Aorta*.

L. The Descending Trunks of the *Vena Cava*.

M. The Ascending Trunks of the *Vena Cava*.

N. The *Coronary Arteries* running upon the right Auricle.

O. The Root of the *Pulmonary Artery* rising from the right Ventricle of the Heart.

P. P. The little Arteries springing from the *Mammary Arteries*, and running upon the Coats of the *Aorta*.

FIGURE II.

Represents the Passage of the Venal Blood into the right Side of the Heart.

- a. The Trunk of the *Vena Cava ascendens*.
- b. The Trunk of the *Vena Cava descendens*.
- c. The Isthmus call'd *Tuberculum Loweri*.
- d. The right Auricle.
- e. The *Foramen Ovale*.
- f. The immediate Entrance into the Heart.
- g. The *Coronary Vein*.
- h. The Heart with the Branches of the *Coronary Veins*.

FIGURE III.

Represents a Segment of the *Aorta* at its exit out of the Heart, with the *Mitral Valves*, (resembling the *Valves* called *Tricuspides* in the Rise of the *Pulmonary Artery*, as it passes out of the right *Ventricle*.)

- a a. Some part of the left *Ventricle*.
- b b b. The three *Semilunar Valves*.
- c. The Inside of the *Aorta*.
- d d. The *Coronary Arteries* rising immediately behind the Valves.
- e e. The Root of the *Aorta* adjoining to the Tendon of the Heart.
- f f. The *Membrana Mitralis* divided, and turn'd on each Side to shew the said Valves.

FIGURE IV.

Represents the Inside of the left Ventricle.

- a a a.* The Pulmonary Vein.
- b b.* The left Auricle.
- c.* The *Foramen Ovale*, where the Blood flows out of the *Cava* into the Pulmonary Vein.
- d. d.* The Mitral Membranes.
- e. e.* The *Papillæ* and *Columnæ* of the left *Ventricle*.
- g.* The Place where the Blood is sent forth into the *Aorta*.
- h.* The Cone of the Heart.
- i i i.* The fibrous Productions of the left *Ventricle*.

FIGURE V.

Represents the Inside of the right Ventricle.

- a a a.*—The Basis of the Right Auricle, where 'tis united to the Tendon of the Heart.
- b b b.* The tendinous Circle whereby 'tis distinguish'd from the *Vena Cava*.
- c c c.* The fleshy Fibres which run to the opposite Tendons.
- d.* The *Coronary Vein*.
- e e.* Other lesser Veins for the reflucent Blood.
- f.* The upper Part of the said Auricle.

PLATE

PLATE II.

FIGURE I.

Represents the Basis of the Heart, with the *Ostia*, surrounded with their Tendons, &c.

- a. The Entrance of the Blood from the *Vena Cava* into the right Ventricle.
- b. The *Ostium*, or Opening through which the Blood is driven out of the right Ventricle into the Pulmonary Artery.
- c. The Entrance of the Blood by the Pulmonary Vein into the left Ventricle.
- d. The Aperture through which the Blood passes from the left Ventricle into the *Aorta*.
- e e e e. The Tendons surrounding the *Ostia* of the Heart.
- f f f f. The Origin and Insertion of the Fibres in the Tendons of the Base.
- g g g g. The Insertion of the interior Fibres which run in an opposite Range to the exterior, and terminate in the same Tendons.

FIGURE II.

Represents the First and Outmost Plan of Fibres.

- a a. The Basis of the Heart.
- b. The Apex, or Cone of the Heart.
- c c c. The straight or right-lined Fibres, which run upwards towards the Base upon the external Superficies of the right Ventricle.

FIGURE III.

Represents the second Plan of Fibres.

- a. The Base, and } of the Heart.
- b. The Cone }
- c. The

- c. The Fibres which form the left Ventricle.
- d. The Fibres which form the right.
- e. The Sinus between the two Ventricles where the Vessels run.

FIGURE IV.

Represents the third Plan of Fibres.

- a. The Base of the Heart.
- b. The Cone.
- c. The right Side.
- d. The left Side.
- e. The Fibres of the Right and
- f. The Fibres of the Left Ventricle.

FIGURE V.

Represents the complicated Fibres which run from the right to the left Ventricle.

- a. The Tendons surrounding the Mouth of the Right and Left Ventricle.
- b. Fibres running from one Tendon to the other, mutually complicating with one another by intermediate Fibres.
- c. The Place where the Fibres (after surrounding the right Ventricle) are bent, and mount obliquely to be inserted into the Tendon of the left Ventricle.

FIGURE VI.

To show how the Fibres, forming and surrounding the left Ventricle, turn in a short spiral Curve at the Cone, and mount obliquely towards the right Ventricle to be inserted into the Tendons of the Base of the Heart..

- a. The Base.
- b. The Cone with the short spiral Curve.
- c. The

- c.* The Fibres ascending obliquely towards the Base of the Heart.
- d.* The Right Side.
- e.* The Left.

FIGURE VII.

Represents the Communication of the interior and exterior Fibres which mutually wreathing about one another, form the Cone of the Heart.

- a.* The Tendons on the { Right and
- b.* } Left Side.
- c.* The Exterior Fibres.
- d.* The Interior.
- e.* The Fibres of both wreathing the Cone of the Heart.

F I N I S.



